SENSITIVITY ANALYSIS OF MALAYSIAN HIGHWAY CAPACITY MANUAL FOR UNSIGNALISED INTERSECTIONS

IZZIAN BINTI IZZUDDIN

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Prepared by	:	IZZIAN BINTI IZZUDDIN
Matric No.	:	14172

Is hereby read and approved by:

_____ _____

Prof. Dr. Wan Hashim Wan Ibrahim Date

Project Supervisor

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN STATUS TESIS

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Alamat Tetap: 474 Kg Wakaf Mek Zainab,
15300 Kota Bharu,
Kelantan Darul Naim

Tarikh: 1 JUN 2009

_____ (TANDATANGAN PENYELIA)

PROF. DR. WAN HASHIM WAN IBRAHIM
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To Mama & Papa

With Lots of Love

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ABSTRACT

Unsignalised intersections play an important role in determining capacity of road network. Two major parameters used in unsignalised intersection analysis are critical gap and follow-up time. There are several factors affecting the critical gap and the follow-up time such as vehicle composition, intersection geometry, major street traffic volume, minor street delay, minor stream approach grade, and others. In this research, the critical gap and the follow-up time were analyzed based on vehicle type, specifically passenger car and motorcycle. Critical gap estimations were based on the Maximum Likelihood method. These two major factors will be used to estimate the level of service and capacity of unsignalised intersections. Malaysian Highway Capacity Manual (MHCM) was produced based on the traffic condition in West Malaysia. The study is to find out the application of MHCM in Sarawak. Sensitivity analysis is being carried out by using MHCM 2006.

ABSTRAK

Persimpangan keutamaan memainkan peranan penting dalam menentukan kapasiti jaringan jalan. Dua parameter utama yang digunakan dalam analisis persimpangan keutamaan adalah sela kritikal dan masa kemajuan. Terdapat beberapa faktor yang mempengaruhi sela kritikal dan masa kemajuan seperti komposisi kenderaan, geometri persimpangan, isipadu lalu lintas utama, kelengahan jalan minor, kecerunan jalan minor dan sebagainya. Dalam kajian ini, sela kritikal dan masa kemajuan dianalisis berdasarkan kenderaan penumpang dan motorsikal. Anggaran sela kritikal adalah berdasarkan kaedah Kebarangkalian Maksimum. Dua faktor utama ini akan digunakan untuk menganggarkan tahap perkhidmatan dan kapasiti bagi persimpangan keutamaan. Panduan Kapasiti Lebuhraya di Malaysia (MHCM) diterbitkan berdasarkan keadaan trafik di Semenanjung Malaysia. Kajian ini adalah untuk mengetahui kebolehan MHCM untuk diaplikasikan di Sarawak. Analisis kesensitifan dijalankan merujuk kepada MHCM 2006.

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HCM	-	Highway Capacity Manual
LOS	-	Level of Service
MHCM	-	Malaysian Highway Capacity Manual
ITS	-	Intelligent Transport System
ROW	-	Right of Way
USHCM	-	United States Highway Capacity Manual
IHCM	-	Indonesia Highway Capacity Manual
MajRT	-	Right Turn Movement from Major Stream
MinLT	-	Left Turn Movement from Minor Stream
MinRT	-	Right Turn Movement from Minor Stream
TRB	-	Transportation Research Board

CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, Malaysia owns modern highway infrastructures and is among the best highway in Asia Tenggara. However, according to Polis DiRaja Malaysia Report for year 1990 - 1995, the accident rates in Malaysia are increasing and need to be concerned about. Besides, traffic congestion and delay is also increasing due to additional number of vehicles on the road. Therefore, a systematic road control needs to be taken by the responsible agencies to reduce traffic congestions.

Unsignalised intersection is a common type of intersection used to control traffic movement. They play an important role in determining overall capacity of road networks. A poorly operating unsignalised intersection may affect adjacent signalized intersection or an Intelligent Transport System. Therefore, it is extremely important to make sure that the intersection is designed appropriately to prevent under or over designed of transportation facilities.

For an unsignalised intersection, the driver alone must decide when it is safe to enter the intersection as there is only stop sign to help them, unlike the signalised intersections. The driver looks for a safe chance or gap in the traffic to enter the flow. This method is called as gap acceptance. Gaps are measured in the unit of time and the time difference between the front bumper of one vehicle to the front bumper of the following vehicle is defined as headway. At unsignalised intersections, there are other vehicles that will have priority over the driver trying to enter the traffic stream and the driver must yield to these drivers.

Critical gap and follow-up time are two major parameters for various gap acceptance capacity models. The values of these two parameters significantly affect the final capacity result, therefore, it is important to accurately measure these two parameters based on certain traffic and intersection conditions. Based on the study by Asmi (2003), the 1997 update to the Highway Capacity Manual (HCM) included a new set of critical gap and follow-up time values calibrated based on the U.S. highway conditions. The newly recommended set of critical gap and follow-up time values formed the basis for the procedures for two-way stop-controlled intersections included in the 1997 update to the HCM and the 2000 HCM. It can be concluded that these two parameters are the major factors to estimate the level of service (LOS) and capacity of unsignalised intersections.

1.2 Problem Statement

Malaysia had produced its own Highway Capacity Manual in 2006 and it is known as Malaysian Highway Capacity Manual (MHCM). MHCM study was based on the traffic condition strictly in West Malaysia. Several locations such as Kuala Lumpur, Ipoh, Malacca and Penang were taken into consideration to bring out the best result.

Driver's behavior is different at a different location. With a low traffic volume and many one-way routes, Sarawak drivers create their own style of driving. Critical gap and follow up time may be differing due to this condition. Therefore, this study is to determine whether the MHCM is applicable to design unsignalised intersections in Sarawak.

1.3 Objectives of the Study

The objectives of this study are as follows:

a) To determine the critical gap by using the Maximum Likelihood method and follow-up time at unsignalised intersections.
b) To carry out sensitivity analysis for unsignalised intersections using Malaysian Highway Capacity Manual 2006.

1.4 Scope of the Study

The study will be carried out in Desa Ilmu, Kota Samarahan, Sarawak, Malaysia. Two unsignalised intersections have been selected as the study areas due to limited time and resources to get the data and they are situated near the Universiti Malaysia Sarawak. Figure 1.1 shows the layout plan of Desa Ilmu with junctions observed are marked with red circle.

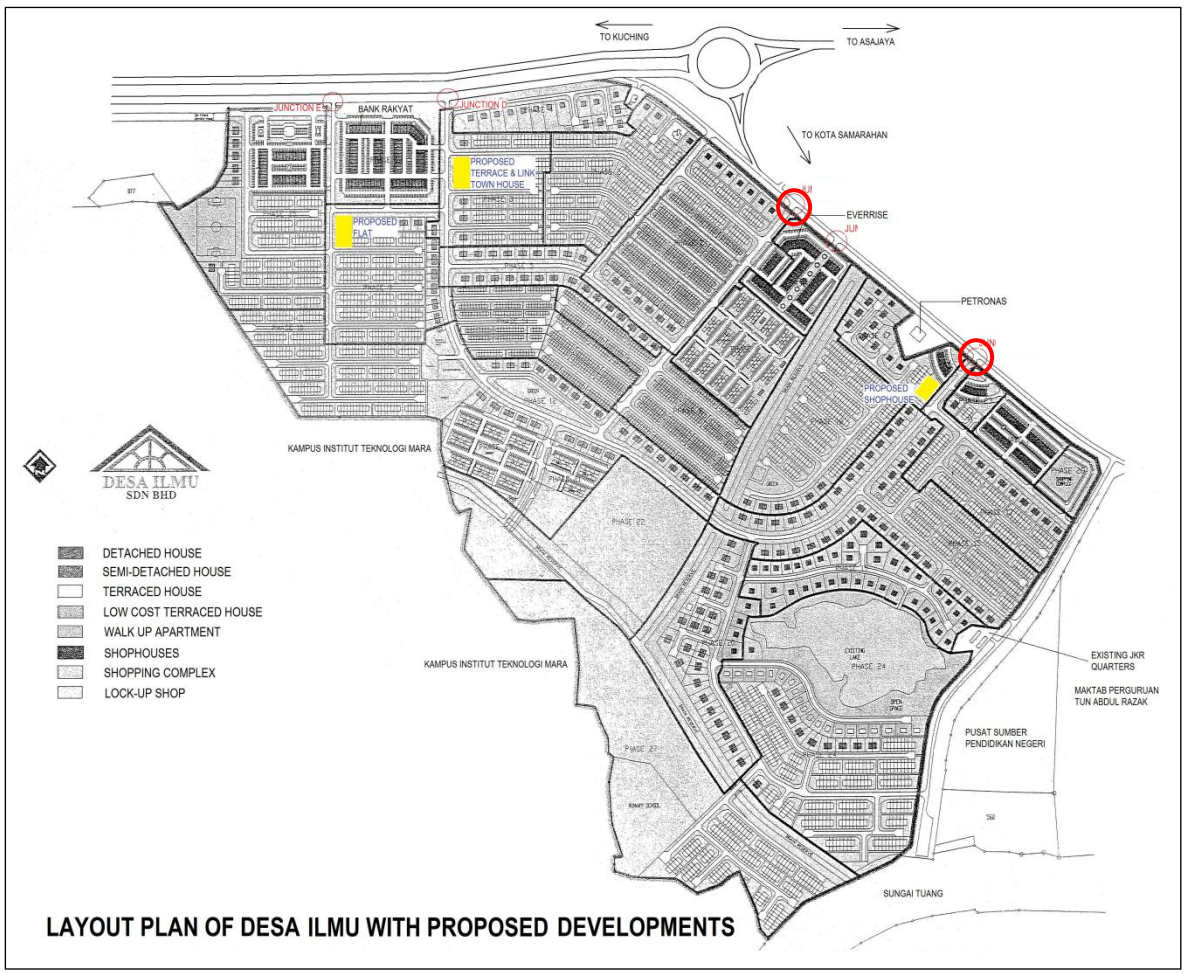

Figure 1.1: The location of the study area

Figure 1.2 shows the illustration of a typical T-junction in Malaysia and the rank of the movements. Ranks of movement are the discipline of the movements at T-junction which have the right of way according to the priority. In this study, only one movement is analysed. The movement is represented by number 9 which is left turn from minor road (LTMin).

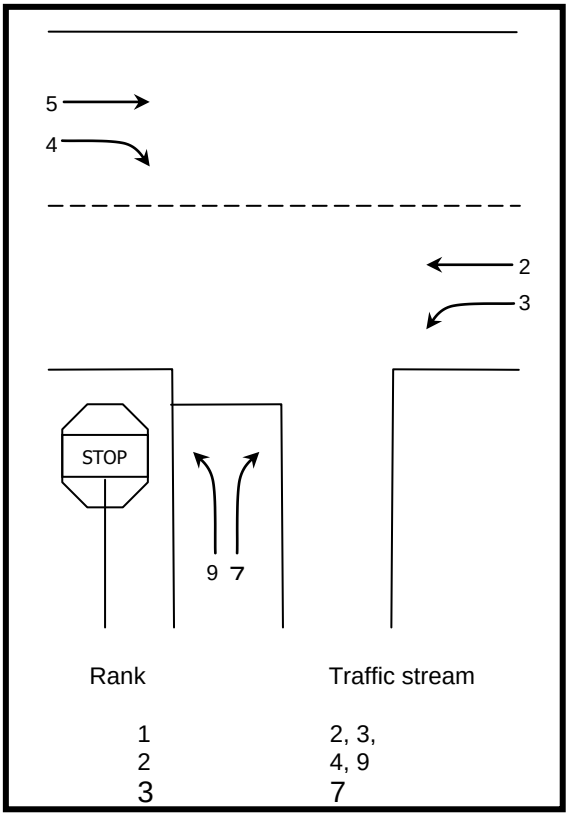

Figure 1.2: Illustration of a typical T-junction in Malaysia (MHCM, 2006)

1.5 Outline of the Report

The first chapter of this study gives a general introduction of the overall study content and the general background of parameters involved in the analysis of unsignalised intersection. The second chapter reviews the relevant literatures related to gap acceptance parameter and follow up time studies. Consequently, Chapter 3 discusses the study methodology carried out for this study. Chapter 4 describes the analysis of the data and discuss the findings. Finally, Chapter 5 concludes and gives some recommendation for this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Unsignalised intersection is the common type of intersections used to control traffic movements. They play an important role in the control of the traffic network system. According to Wua et al. (2005), the study of unsignalised intersection is actually the base of other intersections' study. The interaction between vehicles on different lanes, and the effects of different traffic policies on the traffic volume are not only of scientific significance on the development of traffic theory, but also of guiding importance for establishing suitable traffic policies.

The theory of the operation of unsignalised intersections is fundamental to many elements of theory used for other intersections. Unsignalised intersections do play an important part in the control of traffic flow in a network even though their capacities may be lower than other intersection types. A poorly operating unsignalised intersection may affect a signalised network or operation of an Intelligent Transport System (ITS) (MHCM, 2006).

In Malaysia, majority of the unsignalised intersections is the T-intersection. Majority of the 4-way unsignalised intersections are converted to signalised intersection. T-junction can be described as an intersection where two roads meet (whether or not at right angles) and one of the road ends. It may include an intersection where more than two roads meet but only one continues.

In this study, we are focusing on the unsignalised T-junction to obtain the critical gap and follow-up time for vehicles in Sarawak.

2.2 Unsignalised Intersections

According to Wohl and Martin (1967), unsignalised intersections can be classified into three categories:

1. Uncontrolled intersections
2. Priority intersections
3. Space sharing intersections

An uncontrolled intersection is a road intersection where no traffic lights or signs are used to indicate the right-of-way (ROW). At most locations, uncontrolled intersections are unmarked. Traffic on the terminating road must give way to traffic on the continuing road. They are found in either residential neighborhoods or in rural areas.

At priority intersection, the minor road traffic gives way to that on the main road and only enters the main road traffic stream during gaps. Unlike the uncontrolled intersection, priority intersection normally being controlled by Stop or Give Way signs and markings on the minor road. The advantage of these intersections is all the vehicles on the main road are not being delayed.

There are four types of priority intersections:

1. Simply priority T-intersections
2. Ghost island T-intersections
3. T-intersections with single dualling
4. T-intersections with dual two-lane rural roads

Space sharing at an intersection is intended to permit fully equal priority and continuous movement for all intersecting vehicle flows at the roundabout and weaving areas. The priority at space sharing intersection is not generally assigned to any specific traffic stream. Each traffic stream crosses at a rather low traffic speed and it is normally not necessary to stop.

2.3 Critical Gap Estimation

The critical gap, t_c is the minimum travel time interval between the vehicles of the major stream that is necessary for the vehicles in the minor stream to enter the conflict area (MHCM, 2006).